Final Submission

Executive Summary

INDIANA ARMY AMMUNITION PLANT ENERGY ENGINEERING ANALYSIS

Prepared for

The Department of the Army
Omaha District
Corps of Engineers
Contract No. DACA45-80-C-0090

By

Sanders & Thomas, Inc.
An STV Engineers Professional Firm
Consulting Engineers

DEPARTMENT OF THE ARMY
CONSTRUCTION ENGINEERING RESEARCH LABORATORIES, CORPS OF ENGINEERS
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August 12, 1982

U.S. Army Corps of Engineers
Omaha District
6014 U.S. Post Office and Court House
Omaha, NE 68012

Attention: MROED-MC

Reference: Energy Engineering Analysis
Indiana Army Ammunition Plant, Charlestown, Indiana

Subject: Energy Engineering Analysis - Final Submission

Contract No.: DACA45-80-C-0090

Our Project No.: 05-4660

Gentlemen:

This letter transmits the Final Submission of the Energy Engineering Analysis for the Indiana Army Ammunition Plant. The Analysis presents energy conservation projects that will enable the plant to meet energy consumption reduction goals, as specified in the Army Facilities Energy Plan.

The Analysis consists of seven components: Executive Summary, Technical Report, Appendix I: Master Building List, Appendix II: Energy Conservation Calculations and Data, Appendix III: Summaries of Energy Conservation Measures, Appendix III: Energy Conservation Measures, and Project Programming Documents.

All comments have been reviewed and incorporated in the report, as appropriate.

This Energy Engineering Analysis is a valuable data base that can be used for the development of additional projects as Army goals are revised and other energy conservation projects become viable.

We appreciate this opportunity to be of service and extend our thanks to COE and plant personnel for their invaluable assistance.

Very truly yours,

SANDERS & THOMAS, INC.

David M. Jonik, P.E.
Project Manager

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PROJECT ABSTRACT

ENERGY ENGINEERING ANALYSIS
INDIANA ARMY AMMUNITION PLANT

This analysis is undertaken to assist the Indiana Army Ammunition Plant (INAAP) in meeting the goals established in the Army Facilities Energy Plan to reduce energy consumption by 25 percent by 1985.

Projects selected for implementation as a result of this analysis will enable INAAP to achieve the 1985 goal. Source energy consumed in 1975 was 508,000 MBTU's. This was reduced by INAAP to 346,000 in 1980 for a 42 percent savings. By combining INAAP's conservation effort with the projects described in this report, FY 1985 source energy consumption will be 210,000 MBTU's or a 46 percent reduction.

Projects are divided into Standby and Mobilization Status. Standby status projects will save approximately 58,000 MBTU's. Total energy reduction from FY 80 to the end of FY 85 will be approximately 136,000 MBTU's including 78,000 MBTU's from INAAP's energy conservation effort. The total installed cost of the Standby projects is estimated at approximately $3 million. If Mobilization status projects are implemented source energy consumption can be reduced by an additional 3,365,000 MBTU's. The mobilization project savings are based on full mobilization with no change in the present process. The cost of implementing the Mobilization projects is approximately $20 million.

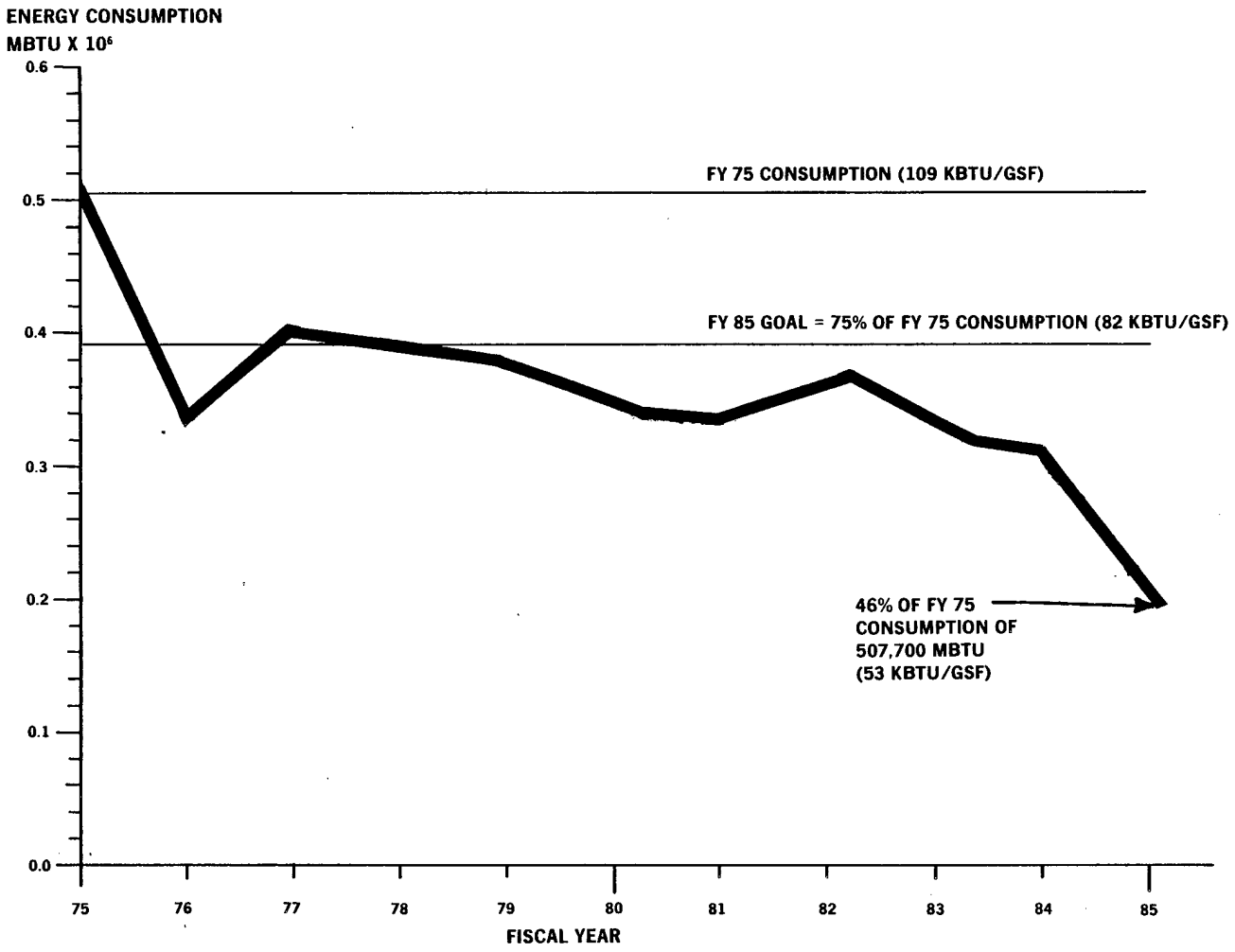

FIGURE 1
PROJECTED ENERGY CONSUMPTION
AS A RESULT OF
ENERGY PROJECT IMPLEMENTATION

SANDERS & THOMAS.
AN STV ENGINEERS PROFESSIONAL FIRM

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DEFINITION OF TERMS

BENEFICIAL OCCUPANCY DATE (BOD)

The date a facility begins to operate.

BENEFIT-TO-COST RATIO (BCR)

The dollar savings realized over the life of the project divided by the non-recurring capital investment (including design). BCR is a measure of project payback. A BCR of 1.0, for example, means that the projects initial capital investment will be recovered over its lifetime.

CURRENT WORKING ESTIMATE (CWE)

The project installation cost escalated to the year the project is programmed for implementation. Installation costs are non-recurring and include all labor and material, contractor costs, bond, contingency, SIOH, and escalation. Design costs are not included and must be added to the CWE to develop the total project cost.

ENERGY-TO-COST RATIO (ECR)

The MBTU's per year saved divided by the non-recurring capital investment (excluding design). ECR is a measure of the amount of energy savings related to the required capital investment. Acceptable ECR's should be lower each year since energy costs escalate faster than capital investment costs.

SIMPLE AMORTIZATION PERIOD (SAP)

The project capital investment divided by the yearly savings. This yields the period of time required to recover the initial capital investment.

TOTAL INSTALLED COST (TIC)

The sum of the CWE and the design costs.

EXECUTIVE SUMMARY

1.1 PROJECT REQUIREMENT

This engineering analysis is undertaken in order to develop a systematic program of projects that will lead to energy consumption reductions at the Indiana Army Ammunition Plant (INAAP) without compromising the mission of the plant, and in compliance with all applicable environmental and Occupational Safety and Health Administration regulations. Reduced energy consumption is a stated goal of the Army Facilities Energy Plan.

The projects included in this analysis are grouped into four increments: A - Energy Conservation and Management Program (ECAM) projects for buildings and processes, B - ECAM projects for utilities and energy distribution systems, E - Feasibility of central boiler plants, and G - Minor construction, maintenance and repair projects.

2.1 PLANT DESCRIPTION

INAAP is a Government-owned, Contractor-operated military industrial installation. ICI Americas, Inc. serves as the plant operator.

INAAP is located near Charlestown, Indiana in close proximity to Louisville, Kentucky. The plant is bounded on the west by Indiana Highway 62 and on the east by the Ohio River. The plant's location in relation to Charlestown and Louisville is shown in Figure 2: Location Map.

INAAP consists of approximately 10,500 acres with over 1,700 buildings, 90 miles of roads, and 84 miles of railroad track. The plant is divided into four sections: Load, Assemble, and Pack (LAP); Propellant and Explosives (P&E); Administrative; and Black Powder. Figures 3 and 4 show the key features of the plant.

The INAAP mission is to manufacture finished propelling charges and bore wear reducing jackets for artillery and to maintain facilities and equipment in support of mobilization requirements.

3.1 ARMY FACILITIES ENERGY PLAN

The Army Facilities Energy Plan sets short and long range energy goals for the Army and provides policy and planning guidance for the development of detailed facility energy plans. The Army's energy energy goals are to:

- Reduce total facility energy consumption by at least 25 percent by FY 1985 and by 50 percent by FY 2000, using FY 1975 as the base year.
- Reduce FY 85 average annual energy consumption per gross square foot of floor area by 45 percent in new buildings compared to FY 1975.

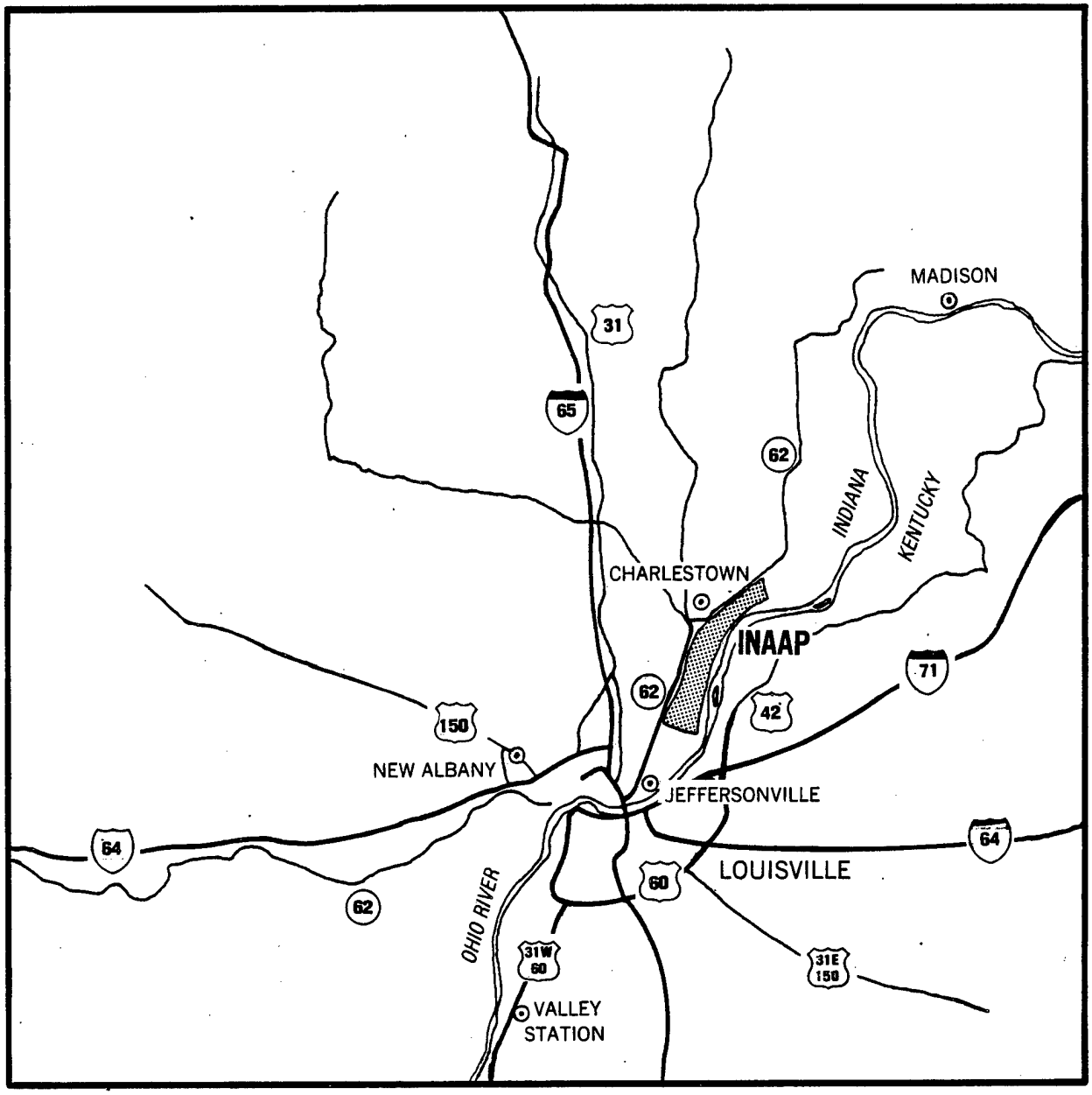
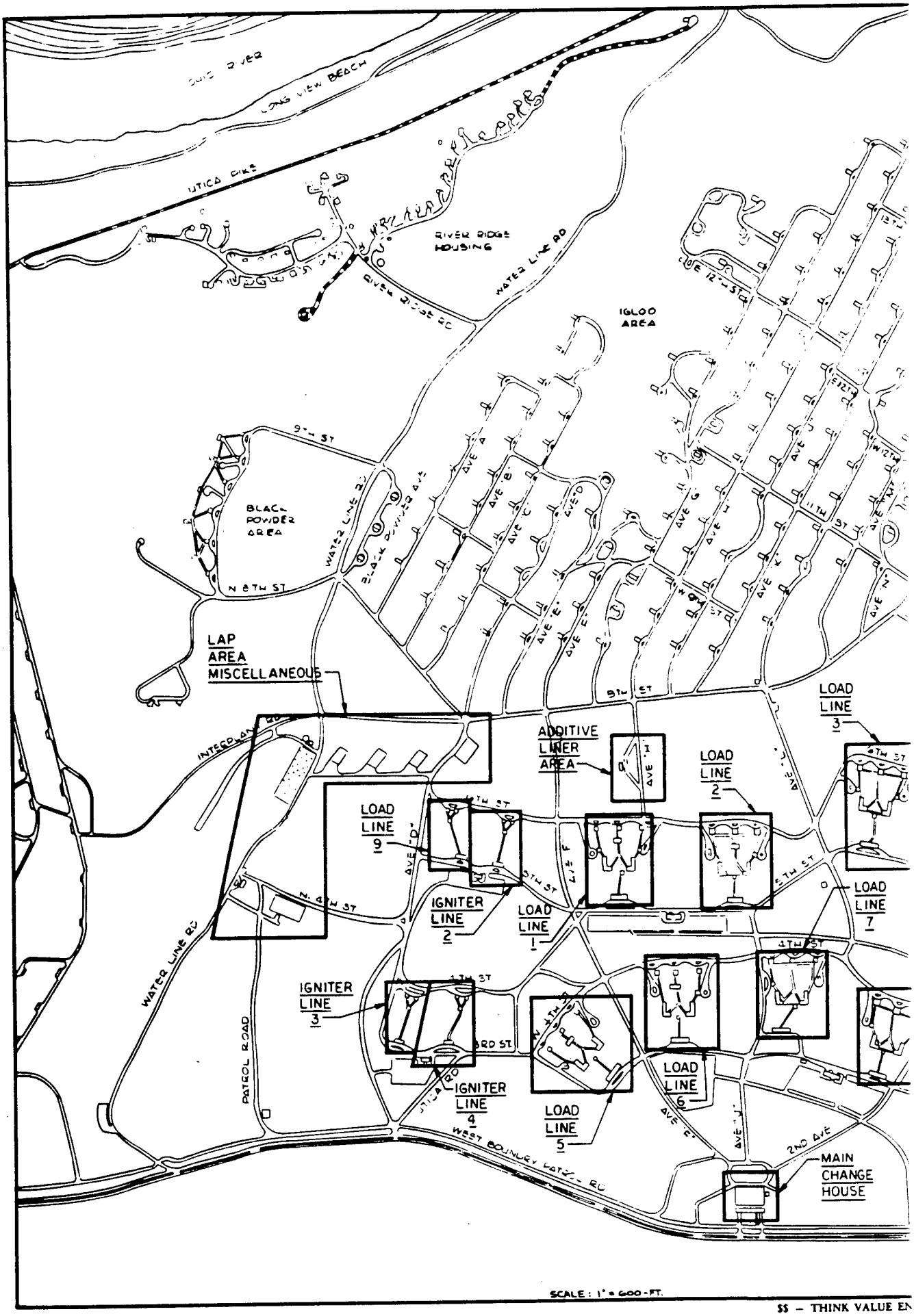


Figure 2
Indiana Army Ammunition Plant
Location Map


LONG VIEW BEACH
UTICA DIKE
RIVER RIDGE HOUSING
WATER LINE RD
IGLOO AREA
BLACK POWDER AREA
WATER LINE 2
BLACK POWDER AVE
9TH ST
N 8TH ST
LAP AREA MISCELLANEOUS
INTERD. AREA
ADDITIVE LINER AREA
LOAD LINE 1
LOAD LINE 2
LOAD LINE 3
LOAD LINE 5
LOAD LINE 6
LOAD LINE 7
LOAD LINE 9
IGNITER LINE 2
IGNITER LINE 3
IGNITER LINE 4
WATER LINE RD
PATROL ROAD
WEST BOUNDARY
MAIN CHANGE HOUSE
SCALE : 1" = 600 - FT.

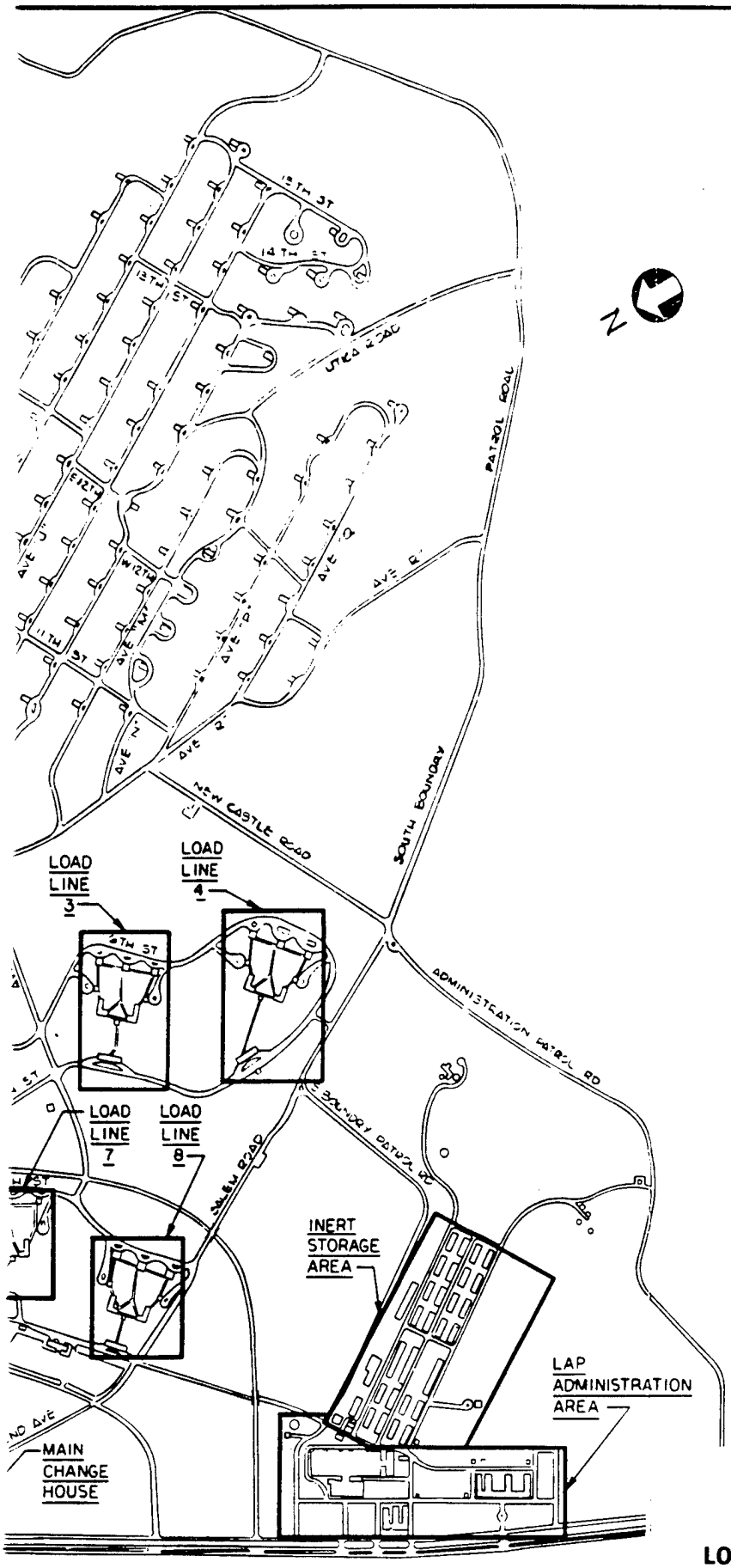
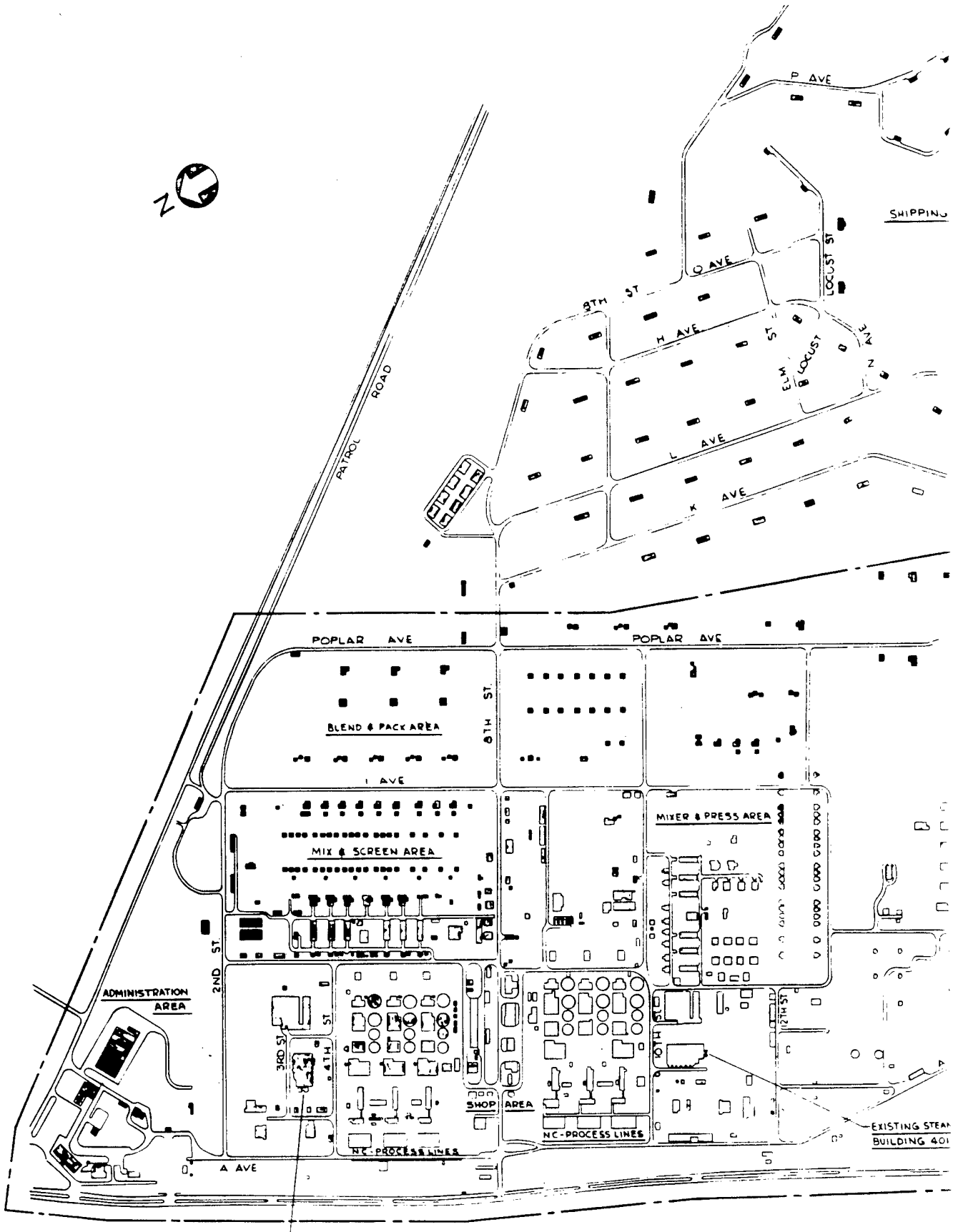


FIGURE 3
INDIANA ARMY AMMUNITION PLANT
LOAD, ASSEMBLE AND PACK AREA SITE PLAN


N
PATROL ROAD
P AVE
SHIPPING
Q AVE
LOCUST ST
8TH ST
H AVE
ELM & LOCUST ST
Z AVE
L AVE
K AVE
POPLAR AVE
POPLAR AVE
BLEND & PACK AREA
8TH ST.
I AVE
MIX & SCREEN AREA
MIXER & PRESS AREA
2ND ST.
ADMINISTRATION AREA
3RD ST
4TH ST
SHOP
AREA
NC-PROCESS LINES
NC-PROCESS LINES
A AVE
EXISTING STEAM/POWER PLANT BUILDING 401-1
SCALE: 1"=600-FT.
AREA SERVED BY EXISTING STEAM/ POWER PLANT

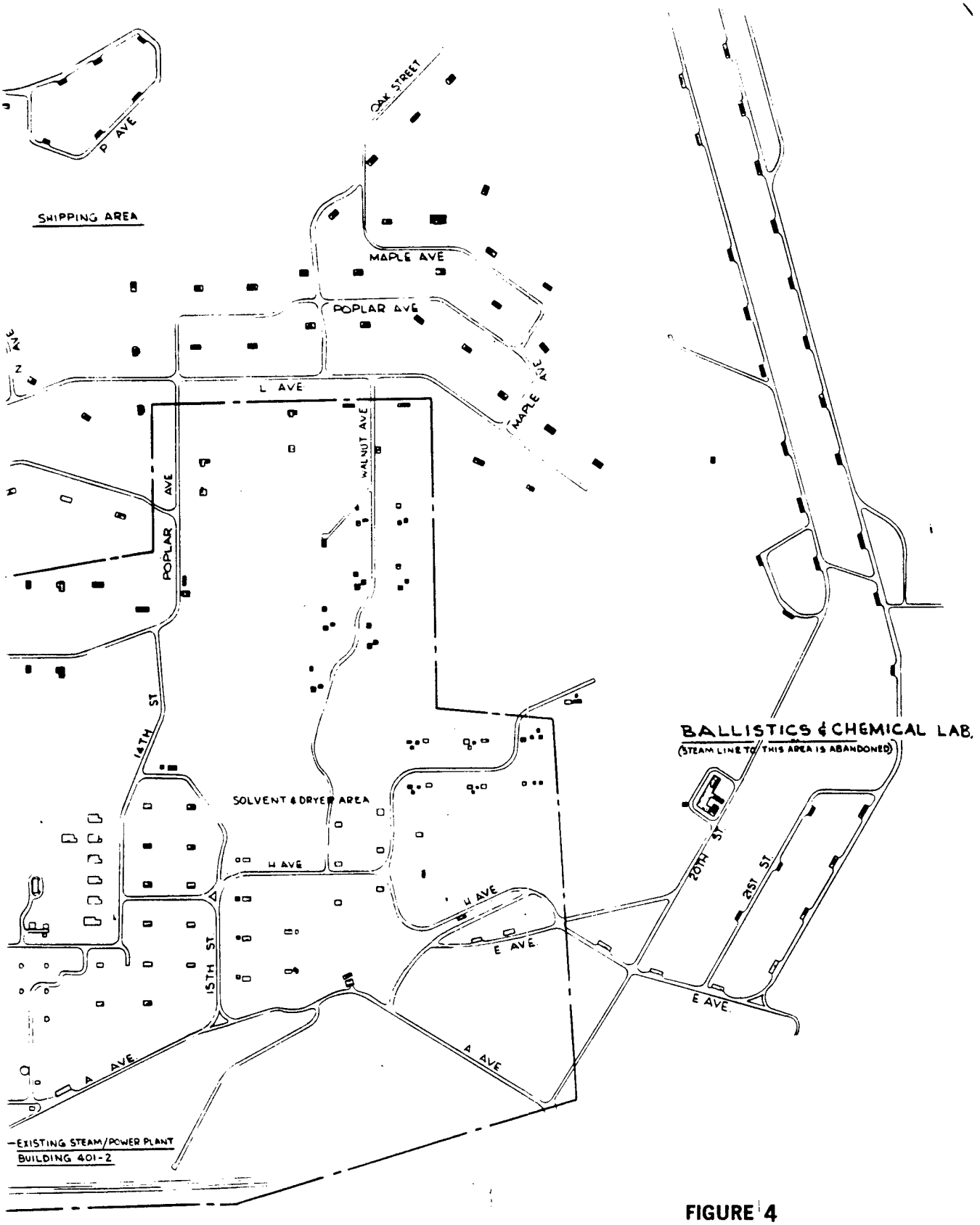


FIGURE 4
INDIANA ARMY AMMUNITION PLANT
P&E AREA SITE PLAN

- Derive ten percent of Army facility energy from coal and alternate fuels by FY 1985.
- Derive one percent of Army facility energy from solar energy by FY 1985.
- Eliminate use of natural gas by FY 2000.
- Reduce facility use of petroleum fuels by 75 percent by FY 2000.

4.1 SOURCE ENERGY CONSUMPTION

Table 1: Source Energy Consumption, compares consumption from FY 1975, the base year for the study, with consumption during FY 1979. Fuel consumption over the period dropped by approximately 33 percent though costs rose 31 percent. Reductions in fuel use can be attributed to plant conservation efforts.

TABLE 1

SOURCE ENERGY CONSUMPTION
FY 1975 AND 1979

	FY 1975		FY 1979	
Source	Cost ($000)	MBTU's Consumed (000)	Cost ($000)	MBTU's Consumed (000)
Electricity	$272	221	$ 464	172
Fuel Oil No. 2	553	287	618	208
Natural Gas	0	0	0	0
Propane Gas	3	1	2	0.5
Totals	$828	509	$1,084	381

5.1 PROJECT EXECUTION

This energy engineering analysis was conducted in four phases:

- Field surveys and data gathering
- Analysis of projects
- Review and verification
- Preparation of Project Programming Documents

5.1.1 Field Surveys and Data Gathering

The field surveys included buildings and process surveys. The surveys were conducted in four areas:

- Architectural - to evaluate such items as wall and roof types and levels of insulation.

- Mechanical - to evaluate heating, ventilating, and air conditioning systems
- Electrical - to evaluate lighting and building electrical systems
- Distribution - to evaluate plant utility systems

The process surveys addressed the processes conducted at the plant and the various recovery systems in operation.

The distribution surveys covered all plant utility systems including electrical, water, and sewage.

The survey phase enabled the identification of energy conservation opportunities and the applicability of energy conservation measures to INAAP.

5.1.2 Analysis of Projects

After the data gathering phase it was possible to identify potential projects for analysis. These projects were analyzed for applicability to INAAP and their potential to save energy in relation to their implementation cost.

5.1.3 Review and Verification

INAAP personnel assisted in the selection of those projects which should be implemented and developed project priorities. All projects were reviewed and verified at the plant in consultation with INAAP personnel.

6.1 ENERGY CONSERVATION OPPORTUNITIES

The following energy conservation opportunities were investigated and found to viable:

Insulation
Storm Windows
Caulking
Weatherstripping
Solar Films
Load Dock Seals
Reduce Glass Area
Reduce Lighting Levels
Replace Incandescent Fixtures
Install Fluorescent Fixtures
Install High-Efficiency Fixtures
√Night Setback Controls
Modify Hot Water Heater Controls
Install Shower Flow Restrictors
✓Reduce Ventilation Requirements
Prevent Air Stratification
Oxygen Control for Boilers
Blowdown Heat Recovery
Revise Boiler Controls
Install Economizers
Install New Burners
Reduce Street Lighting
Insulate Steam Lines
Return Condensate

The following conservation opportunities were studied but found not viable because of low ECR or lack of conservation opportunity at the plant:

- Replace kitchen lighting fixtures
- Improve power factor
- High-efficiency motor replacement
- FM radio controls
- Decentralize domestic hot water heaters
- Reclaim heat from hot refrigerant gas
- Install chiller controls
- Replace chillers

7.1 ECAM PROJECTS SELECTED FOR IMPLEMENTATION

ECAM projects, selected for standby ~~and mobilization~~ status, are shown in Table 2: ECAM Projects Selected for Implementation.

TABLE 2

ECAM PROJECTS SELECTED FOR IMPLEMENTATION

Project No.	Project Title	Annual MBTU Savings	Annual Cost Savings ($000)	Benefits ($000)	CWE ($000)	TIC ($000)	SAP	BCR	ECR
	FY 85 Standby Status								
6-6 & 12-5	Repair & Replace Steam Traps and Insulate Steam and Hot Water Lines	10,400	~~135~~ 67	2,711	118	124	1	22	88
5-1	Misc. Building Insulation	12,900	137	2,699	444	468	3	6	29
6-3	Disconnect Trans-formers	3,200	13	250	201	212	16	1	16
8-1	Install Small Air Compressors	6,900	33	589	478	503	15	1	14
11-1	EMCS Expansion	6,400	~~197~~	901	187	197	3	5	34
	SUBTOTAL	39,800	515	7,150	1,428	1,504			

8.1 VIABLE PROJECTS NOT SELECTED FOR IMPLEMENTATION

Table 3: Viable Projects Not Selected for Implementation, shows these projects which meet ECAM guidelines but were not selected by INAAP personnel.

TABLE 3

VIABLE PROJECTS NOT SELECTED FOR IMPLEMENTATION

Project No.	Project Title	Annual Energy Savings MBTU's	CWE ($000)	TIC ($000)	SAP	BCR	ECR	Status*
9-1	Reclaim Heat from Poaching Tanks	2,565,000	5,380	5,665	1	19	477	M
6-5	Repair and Replace Steam Traps	389,000	2,444	2,574	1	40	159	M
9-2	Reclaim Heat from Boiling Tubs	282,000	5,325	5,605	7	2	53	M
6-4	Replace Insulation P&E Area	123,000	6,695	7,050	4	5	18	M
6-2	Replace Exterior Lighting	1,800	133	140	3	4	13	M
6-1	Replace Fence Lighting	4,200	347	363	14	1	12	M
	SUBTOTAL	3,365,000	20,324	21,397				

*Status: S - Standby
M - Mobilization

9.1 INFEASIBLE PROJECTS

Table 4: Infeasible Projects, are those projects that were found to have limited applicability to the plant, were already completed, or did not meet ECAM guidelines.

TABLE 4

INFEASIBLE PROJECTS

Project No.	Project Title	Annual Energy Savings MBTU's	CWE ($000)	TIC ($000)	SAP	BCR	ECR	Status*
6-7	Repair Damaged Insulation	10,800	102	108	1	26	105	S
	SUBTOTAL	10,800	102	108				

*Status: S - Standby

10.1 MINOR CONSTRUCTION, MAINTENANCE, AND REPAIR PROJECTS (INCREMENT "G" PROJECTS)

Minor construction, maintenance, and repair projects selected for implementation are shown in Table 5. Projects are listed for both standby and mobilization status. Projects are shown in order of descending ECR.

TABLE 5

MINOR CONSTRUCTION, MAINTENANCE, AND REPAIR PROJECTS
(INCREMENT "G" PROJECTS)

Project No.	Project Title	Annual MBTU Savings	Annual Cost Savings ($000)	TIC ($000)	ECR	SAP	Manhours
12-1	Small Compressor for Pneumatic Controls	4,600	11	18	267	2	140
5-2	Misc. Building Lighting	2,450	12	52	50	4	497
12-7	Heat Destratification Bldg. 2551 & 2561	1,210	16	28	46	2	400
12-9	Reduce Infiltration in Bldg. 3011	430	6	17	26	3	240
	SUBTOTAL	8,690	45	115			

11.1 SUMMARY OF PROJECTS

Table 6: Summary of Projects, presents a summation of energy savings and costs for all categories of projects.

TABLE 6

SUMMARY OF PROJECTS

	MBTU/Yr Energy Savings	Total Installed Cost ($000)
Selected ECAM Standby Projects	39,800	$ 1,504
Selected ECAM Mobilization Projects	0	0
Projects Not Selected - Standby	0	0
Projects Not Selected - Mobilization	3,365,000	20,324

TABLE 6 (Continued)

	MBTU/Yr Energy Savings	Total Installed Cost ($000)
Increment G Projects - Standby	8,687	115
Increment G Projects - Mobilization	0	0
	3,413,490	$21,943

12.1 PROJECED ENERGY TRENDS

Figure 5: Standby Status Projected Energy Consumption, shows the projected energy consumption trend over the period FY 1975 to FY 2000 as a result of implementing projects developed by INAAP and the projects described in this report. From FY 1983 to FY 1985, when the energy projects will be implemented, energy use will decline by 118,000 MBTU's. Building energy use per square foot will be reduced from 109 to 53 KBTU's per gross square foot per year over the same period.

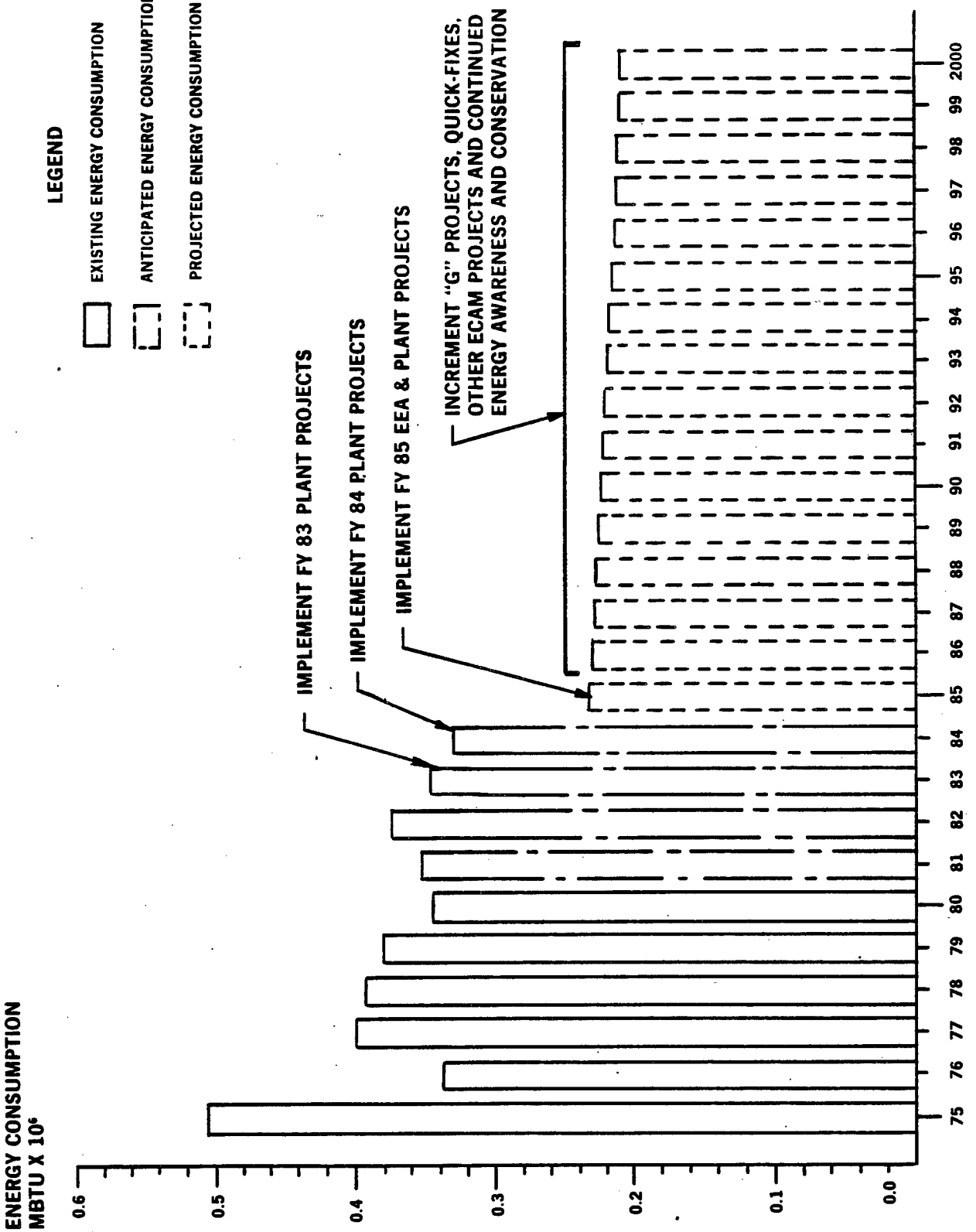
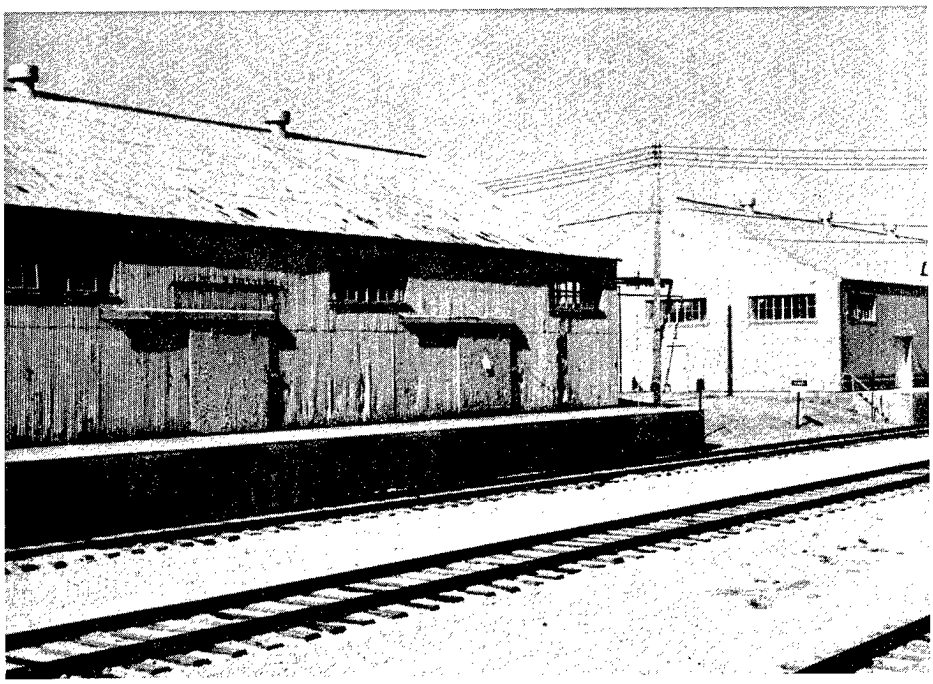
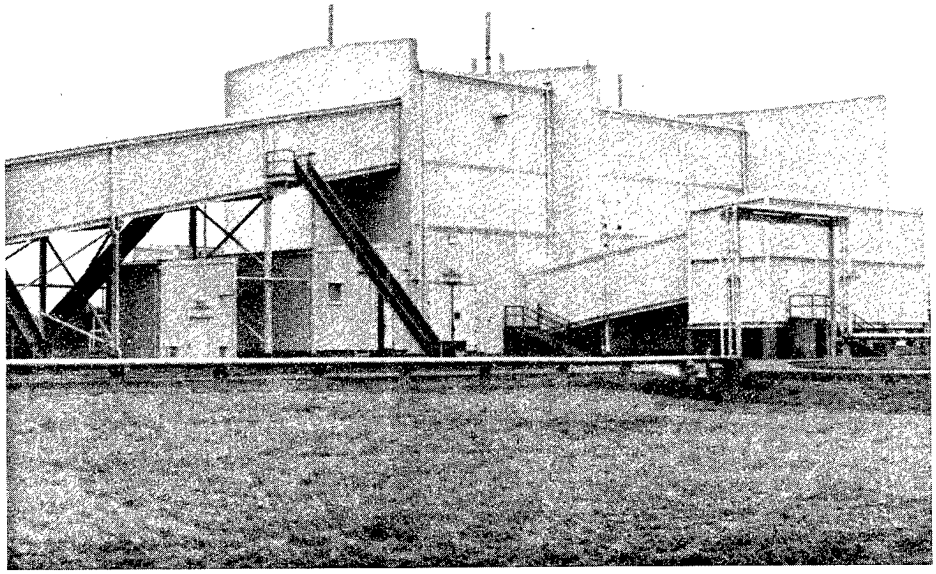


FIGURE 5

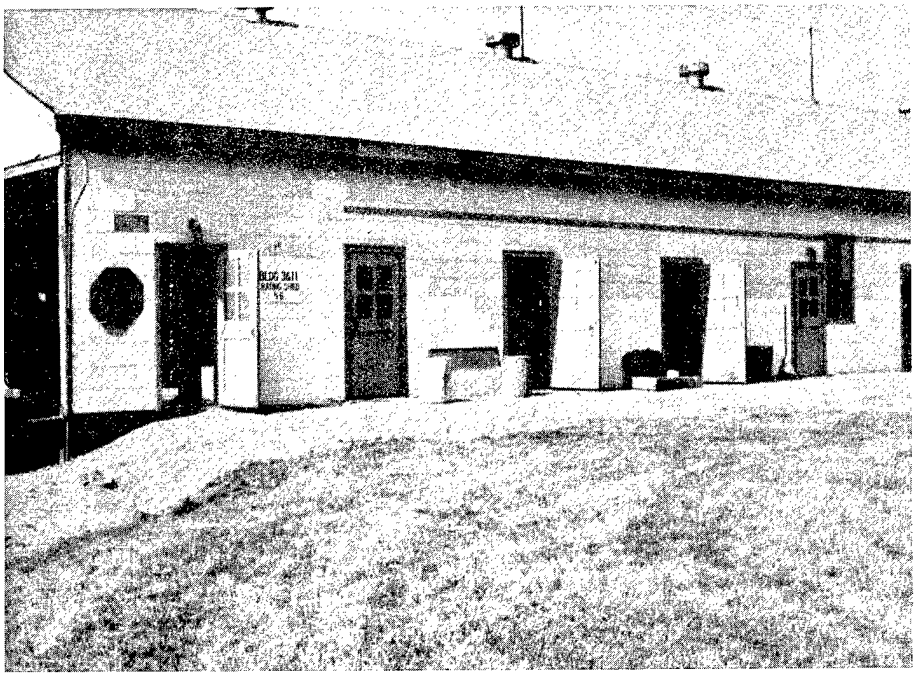
STANDBY STATUS-PROJECTED ENERGY CONSUMPTION



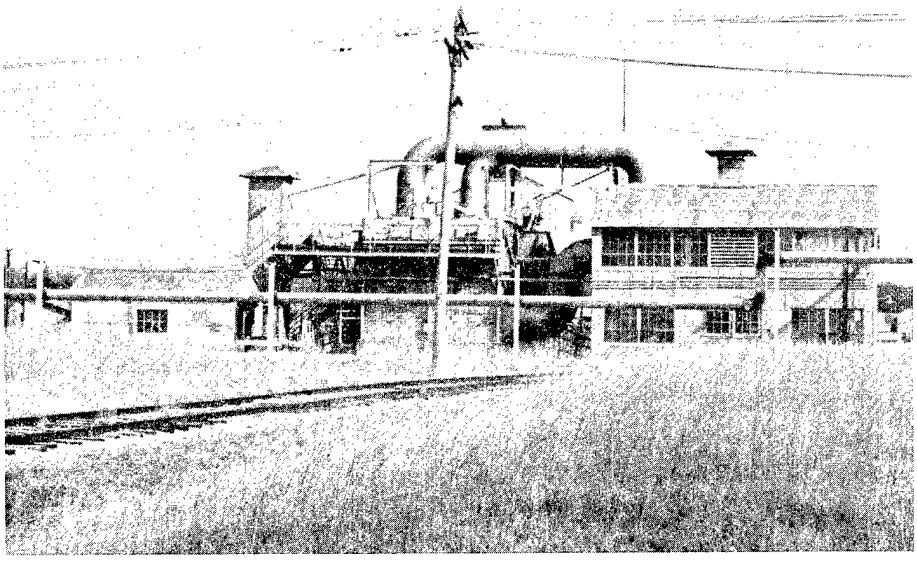
LAP WAREHOUSE AREA — STEEL FRAME CORRUGATED SIDING



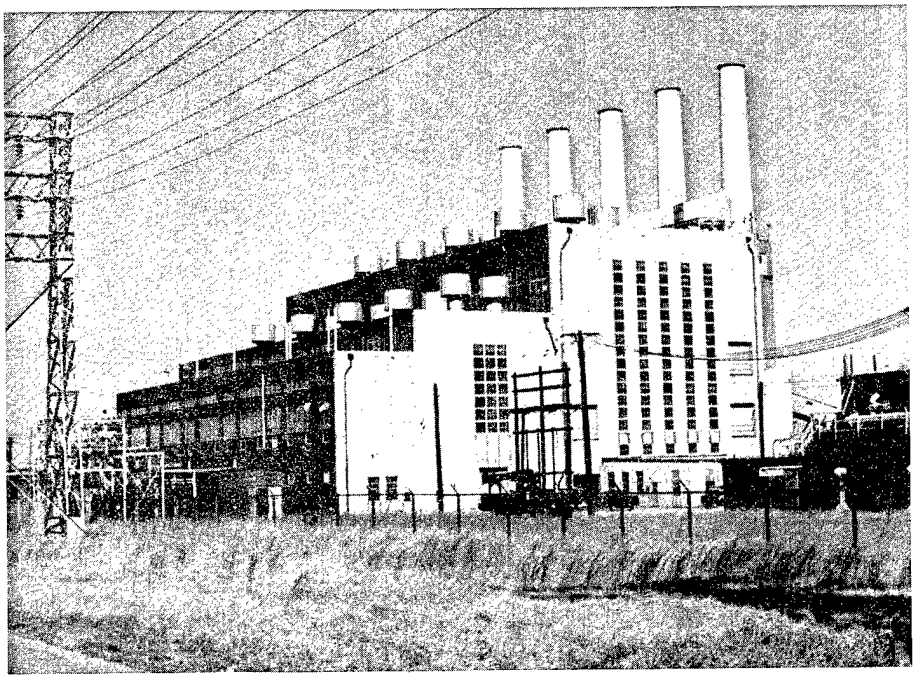
NEW BLACK POWDER AREA PROCESSING — CONCRETE AND STEEL FRAMING WITH CORRUGATED SIDING



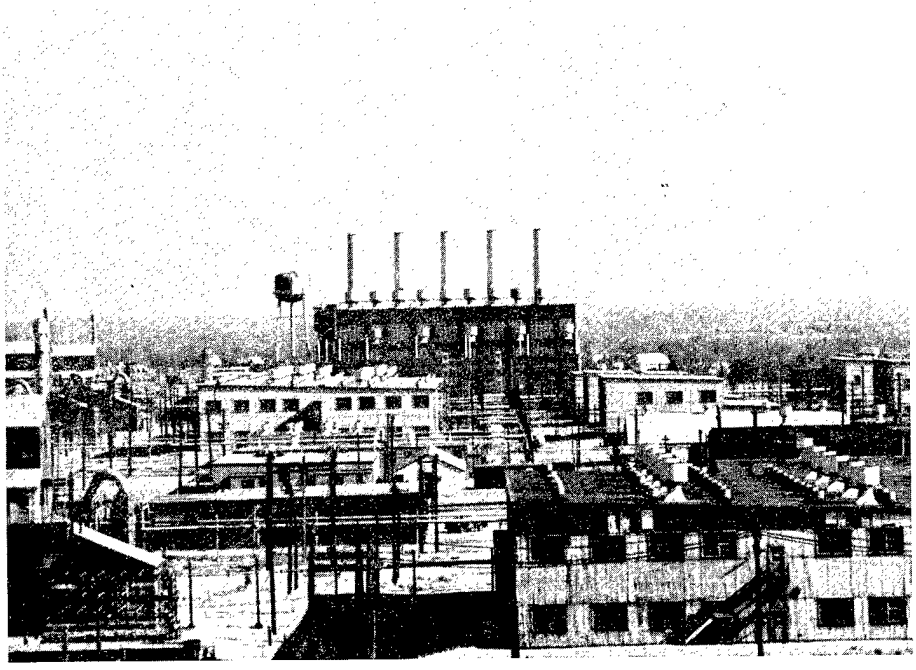
BUILDING 3611 — WOOD FRAME WITH ASBESTOS SHINGLES



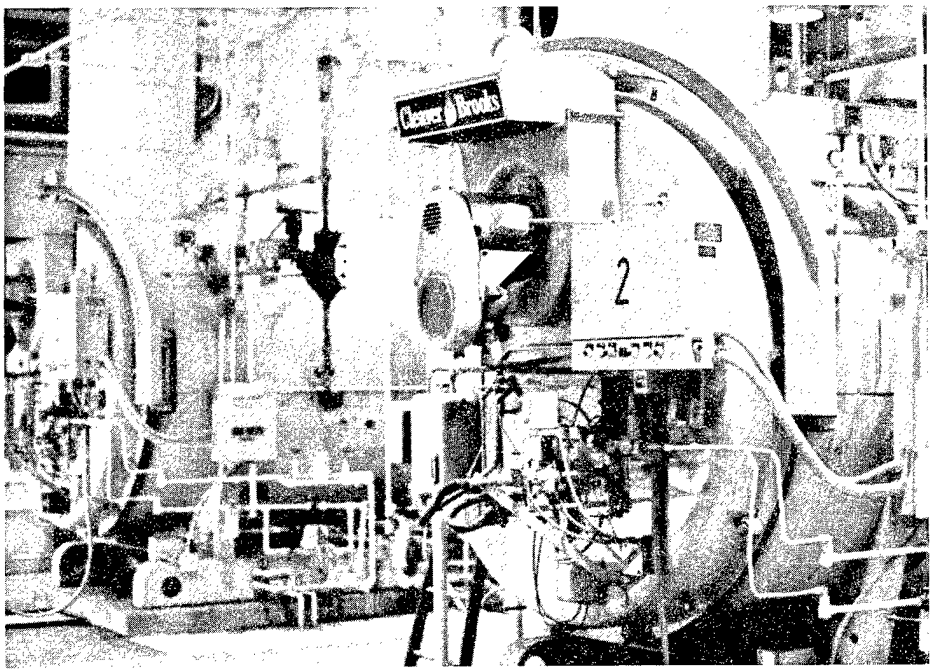
BUILDING 220 — CC DRYER. ASBESTOS SIDING WITH LARGE WINDOW AREA



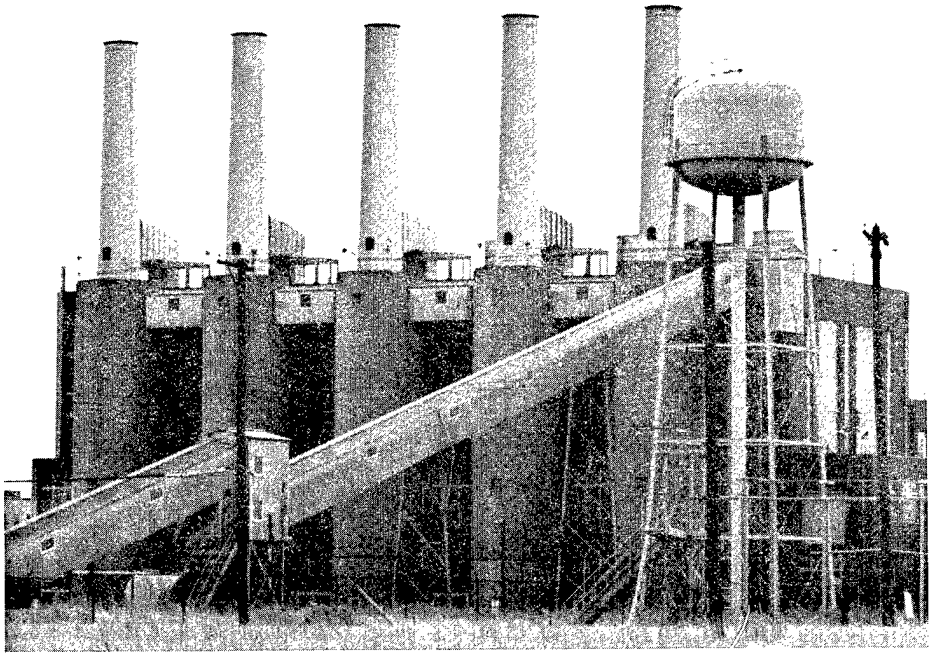
BOILER HOUSES



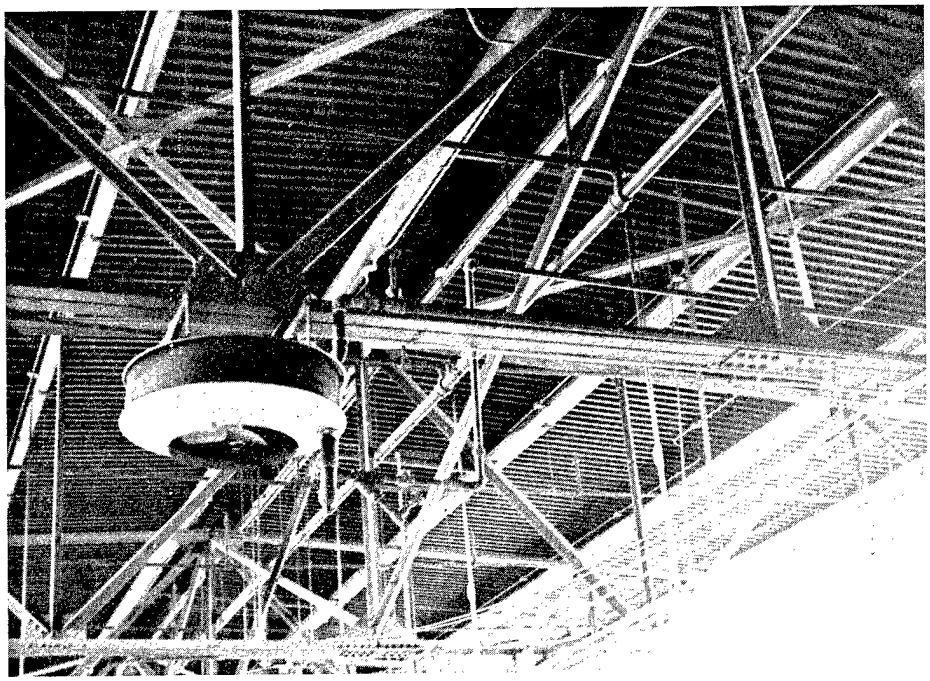
BOILER PLANT — P&E AREA



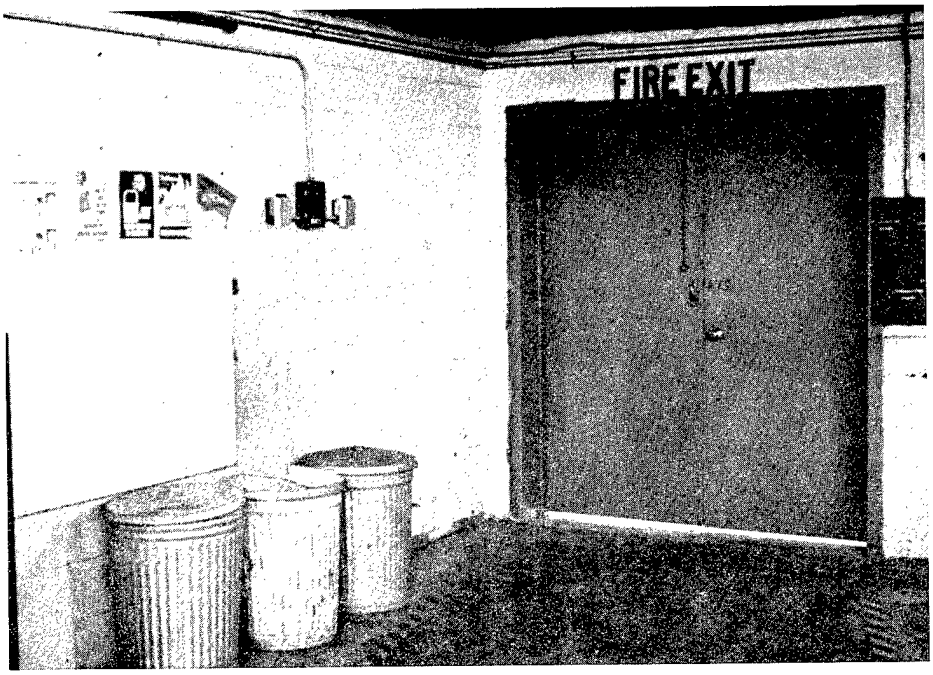
BOILERS IN BLACK POWDER AREA



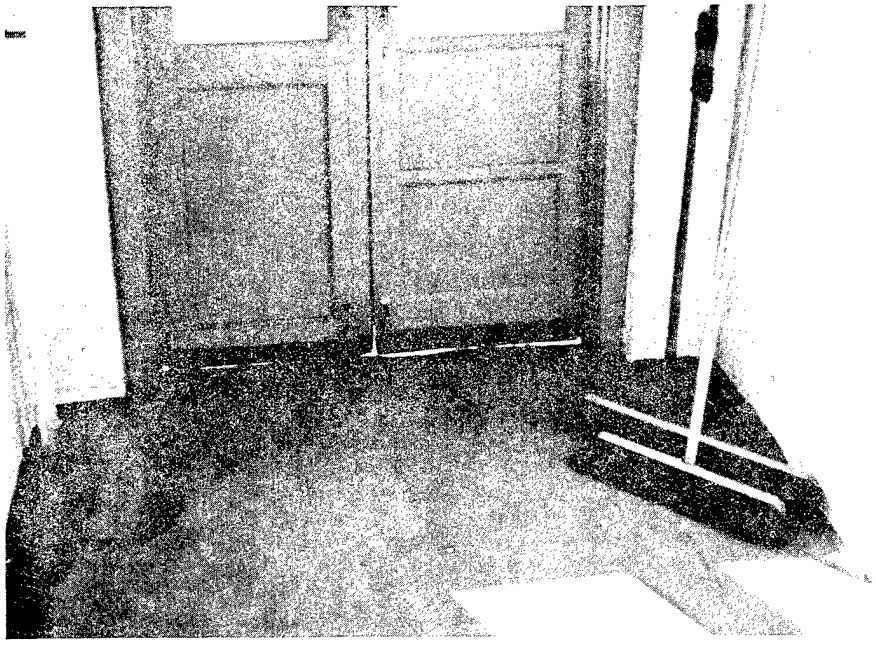
SOUTHERN VIEW OF BUILDING 401-1 BOILER HOUSES



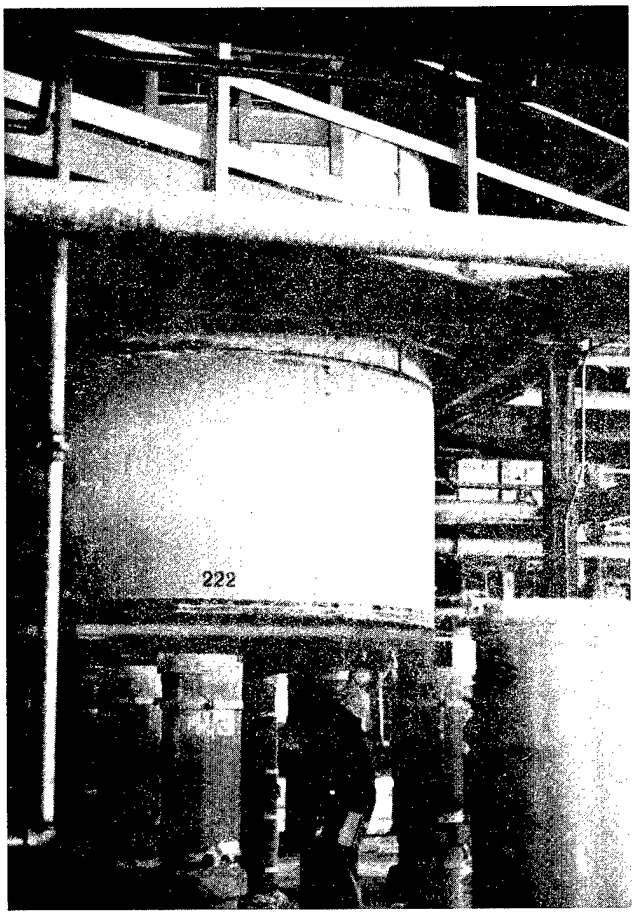
POTENTIAL PROJECT TO INSULATE STEAM LINES AND INSTALL HIGH-BAY AREA DESTRATIFICATION UNITS IN BUILDING 1503



THERMOSTATS ARE LOCATED NEXT TO POOR-FITTING DOORS IN BUILDING 1503



INFILTRATION DUE TO LACK OF DOOR SILL IN BUILDING 3011 (LOAD LINE 5B)



NITROCELLULOSE PROCESSING - TYPICAL UNINSULATED HEATED TANK (BUILDING 112-1)